

## REMARKS

Claims 1, 9-11, 19 and 20 are amended. Claims 1-20 are in the application for consideration.

The Examiner asserts that copies of cited prior art were not provided in a Supplemental Information Disclosure Statement (IDS) received by the U.S. Patent and Trademark Office (PTO) on March 12, 2002. Attached hereto is a copy of the postcard which accompanied said Supplemental IDS and which was stamped as received by the PTO. The postcard clearly states that "[c]opies of 7 references" were included with the filing. However in an abundance of caution, being filed herewith is another Supplemental IDS and Form PTO-1449 with copies of those same seven cited references to replace the ones apparently misplaced by the PTO. It is requested that the Examiner initial the art on the PTO-1449 and print the references on the face of the patent.

Each of the independent claims in this application has been amended to recite that a conductive layer is disposed along the lateral wall of the contact plug, with the conductive layer having the contact plug on one side of its two opposite sides and having the spacer and the layer of doped silicon dioxide on the other of such sides. Further, it is recited that the conductive layer is a refractory metal.

The cited Lee et al. reference is not in any way seen to disclose or suggest a conductive layer disposed on the lateral wall of the contact plug which is a refractory metal. Rather, Lee et al. is only understood to disclose or suggest the utilization of a refractory metal compound, and not solely a refractory metal. Accordingly, each of Applicant's independent claims now recites something which is neither shown nor suggested in the cited collection of the

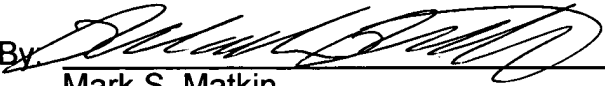
Bronner et al., Lee et al., Havemann and Ahmad et al. references. As each of the references is lacking in this regard, no one or combination of the same renders obvious Applicant's independent claims as amended herein. Accordingly, allowance of claims 1, 9-11, 19 and 20 is urged.

Applicant's dependent claims should be allowed as depending from allowable base claims, and for their own recited features which, in combination, are neither shown nor suggested in the above-cited art.

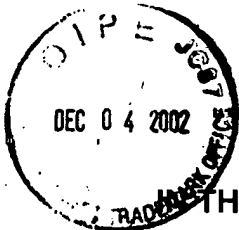
This application is believed to be in immediate condition for allowance, and action to that end is requested.

Respectfully submitted,

Dated: 12-4-02

By:   
Mark S. Matkin  
Reg. No. 32,268

*Attachment: Postcard that accompanied Supp. IDS mailed 02/28/02 - PTO receipt stamped 03/12/02*



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THE UNITED STATES PATENT AND TRADEMARK OFFICE

Application Serial No. . . . . 09/579,402  
Filing Date . . . . . May 25, 2000  
Inventor . . . . . Kei-Yu Ko  
Assignee . . . . . Micron Technology, Inc.  
Group Art Unit . . . . . 2815  
Examiner . . . . . Eugene Lee  
Attorney's Docket No. . . . . MI22-2042  
Title . . . . . Gate Stack Structure

**VERSION WITH MARKINGS TO SHOW CHANGES MADE  
ACCOMPANYING RESPONSE TO SEPTEMBER 11, 2002 OFFICE ACTION**

**In the Claims**

The claims have been amended as follows. Underlines indicate insertions  
and ~~strikeouts~~ indicate deletions.

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1. (Thrice Amended) A gate stack structure situated over a semiconductor material layer, said gate stack structure comprising:

- a gate oxide layer on said semiconductor material layer;
- a gate layer, comprising a first conductive material, on said gate oxide layer;
- a layer of refractory metal silicide on said gate layer;
- an undoped silicon dioxide cap on and in contact with said layer of refractory metal silicide;
- a spacer over a lateral side of the gate layer and in contact with said semiconductor material layer, said spacer comprising a nonconductive material, wherein the lateral side of the gate layer is oriented perpendicular to said base semiconductor material layer;
- a contact plug having a base in contact with said semiconductor material layer, said contact plug comprising a second conductive material and being situated adjacent to the gate layer, over said spacer, and over a portion of said undoped silicon dioxide cap, said contact plug having a top and a lateral wall extending from said top to said base, wherein said lateral wall is not vertical along its height from said top to said base; and
- a layer of doped silicon dioxide over and in contact with said spacer, over and in contact with said undoped silicon dioxide cap, and adjacent to and in contact with said contact plug, wherein a ~~refractory-metal~~ conductive layer is disposed along said lateral wall of said contact plug, said ~~refractory-metal~~ conductive layer having said contact plug on one of its two opposite sides and having said spacer and said layer of doped silicon dioxide on the other of said sides, such that said ~~refractory-metal~~ conductive layer ~~comprises one of the~~

~~materials selected from the group consisting of~~ is a refractory metal, a refractory metal silicide, and combinations thereof.

9. (Thrice Amended) A gate stack structure situated over a monocrystalline silicon layer, said gate stack structure comprising:

- a gate oxide layer on said monocrystalline silicon layer;
- a polysilicon gate layer on said gate oxide layer;
- a layer of tungsten silicide on said polysilicon gate layer;
- an undoped silicon dioxide cap on and in contact with said layer of tungsten silicide;

- a spacer over a lateral side of the gate layer and in contact with said monocrystalline silicon layer, said spacer comprising undoped silicon dioxide and being integral with the undoped silicon dioxide cap, wherein the lateral side of the gate layer is oriented perpendicular to said base monocrystalline silicon layer;

- a contact plug having a base in contact with said monocrystalline silicon layer, said contact plug comprising a second conductive material and being adjacent to said gate layer, over said spacer, and over a portion of said undoped silicon dioxide cap, said contact plug having a top and a lateral wall extending from said top to said base, wherein said lateral wall is not vertical along its height from said top to said base; and

- a layer of doped silicon dioxide comprising a material selected from the group consisting of BPSG, PSG, and BSG, and being situated over and in contact with said spacer, over and in contact with said undoped silicon dioxide cap, and adjacent to and in contact with said contact plug, wherein a ~~refractory metal~~ conductive layer is disposed along said lateral wall of said contact plug, said ~~refractory metal~~ conductive layer having said contact plug on one of its two opposite sides and having said spacer and said layer of doped silicon dioxide on the other of said sides, such that said ~~refractory metal~~ conductive layer

~~comprises one of the materials selected from the group consisting of~~ is a  
~~refractory metal, a refractory metal silicide, and combinations thereof.~~

10. (Four Times Amended) A gate stack structure situated over a monocrystalline silicon layer, said gate stack structure comprising:

- a gate oxide layer on said monocrystalline silicon layer;
- a polysilicon gate layer on said gate oxide layer;
- a layer of tungsten silicide on said polysilicon gate layer;
- an undoped silicon dioxide cap on and in contact with said layer of tungsten silicide;

- a spacer over a lateral side of the gate layer and in contact with said monocrystalline silicon layer, said spacer comprising a material that is one of silicon nitride and undoped silicon dioxide and being made from the same material as the undoped silicon dioxide cap, wherein the lateral side of the gate layer is oriented perpendicular to said monocrystalline silicon layer;

- a contact plug having a base in contact with said monocrystalline silicon layer, said contact plug comprising a second conductive material and being adjacent to said gate layer, over said spacer, and over a portion of said undoped silicon dioxide cap, said contact plug having a top and a lateral wall extending from said top to said base, wherein said lateral wall is not vertical along its height from said top to said base; and

- a layer of doped silicon dioxide comprising a material selected from the group consisting of BPSG, PSG, and BSG, and being situated over and in contact with said spacer, over and in contact with said undoped silicon dioxide cap, and adjacent to and in contact with said contact plug, wherein a ~~refractory metal~~ conductive layer is disposed along said lateral wall of said contact plug, said ~~refractory metal~~ conductive layer having said contact plug on one of its two opposite sides and having said spacer and said layer of doped silicon dioxide on the other of said sides, such that said ~~refractory metal~~ conductive layer



~~comprises one of the materials selected from the group consisting of is a refractory metal, a refractory metal silicide, and combinations thereof.~~

11. (Thrice Amended) A gate structure comprising:

a pair of gate stacks situated over a semiconductor material layer, each said gate stack comprising:

- a gate oxide layer on said semiconductor material layer;
- a gate layer, comprising a first conductive material, on said gate oxide layer;
- a layer of refractory metal silicide on said gate layer;
- an undoped silicon dioxide cap on and in contact with said layer of refractory metal silicide; and

a spacer in contact with a lateral side of each said gate stack and with said semiconductor material layer, said spacer comprising a nonconductive material, each said lateral side of each said gate stack being perpendicular to said base semiconductor material layer;

a contact plug having a base in contact with said semiconductor material layer, said contact plug comprising a second conductive material and being situated between said pair of gate stacks, over said spacer, and over a portion of said undoped silicon dioxide cap, said contact plug having a top and a lateral wall extending from said top to said base, wherein said lateral wall is not vertical along its height from said top to said base; and

a layer of doped silicon dioxide over and in contact with said spacer, over and in contact with said undoped silicon dioxide cap, and adjacent to and in contact with said contact plug, wherein a ~~refractory metal~~ conductive layer is disposed along said lateral wall of said contact plug, said ~~refractory metal~~ conductive layer having said contact plug on one of its two opposite sides and having said spacer and said layer of doped silicon dioxide on the other of said sides, such that said ~~refractory metal~~ conductive layer ~~comprises one of the~~

~~materials selected from the group consisting of~~ is a refractory metal, a refractory metal silicide, and combinations thereof.

19. (Four Times Amended) A gate structure comprising:

a pair of gate stacks situated over a monocrystalline silicon layer, each said gate stack comprising:

- a gate oxide layer on said monocrystalline silicon layer;
- a polysilicon gate layer on said gate oxide layer;
- a layer of tungsten silicide on said polysilicon gate layer;
- an undoped silicon dioxide cap on and in contact with said layer of tungsten silicide; and

a spacer over a lateral side of each said gate stack and in contact with said monocrystalline silicon layer, said spacer comprising undoped silicon dioxide and being made from the same material as the undoped silicon dioxide cap, wherein the lateral side of each side gate stack is oriented perpendicular to said monocrystalline silicon layer;

a contact plug having a base in contact with said monocrystalline silicon layer, said contact plug comprising a second conductive material and being situated between said pair of gate stacks, over said spacer, and over a portion of said undoped silicon dioxide cap, said contact plug having a top and a lateral wall extending from said top to said base, wherein said lateral wall is not vertical along its height from said top to said base; and

a layer of doped silicon dioxide over and in contact with said spacer, over and in contact with said undoped silicon dioxide cap, and adjacent to and in contact with said contact plug, wherein a ~~refractory-metal~~ conductive layer is disposed along said lateral wall of said contact plug, said ~~refractory-metal~~ conductive layer having said contact plug on one of its two opposite sides and having said spacer and said layer of doped silicon dioxide on the other of said sides, such that said ~~refractory-metal~~ conductive layer ~~comprises one of the~~

~~materials selected from the group consisting of~~ is a refractory metal, a refractory metal silicide, and combinations thereof.

20. (Thrice Amended) A gate structure comprising:

a pair of gate stacks situated over a monocrystalline silicon layer, each said gate stack comprising:

- a gate oxide layer on said monocrystalline silicon layer;
- a polysilicon gate layer on said gate oxide layer;
- a layer of tungsten silicide on said polysilicon gate layer;
- an undoped silicon dioxide cap on and in contact with said layer of tungsten silicide; and

a spacer over a lateral side of each said gate stack and in contact with said monocrystalline silicon layer, said spacer comprising a material that is one of silicon nitride and undoped silicon dioxide, each said lateral side of each said gate stack being perpendicular to said monocrystalline silicon layer;

a contact plug having a base in contact with said monocrystalline silicon layer, said contact plug comprising a second conductive material and being situated between said pair of gate stacks, over said spacer, and over a portion of said undoped silicon dioxide cap, said contact plug having a top and a lateral wall extending from said top to said base, wherein said lateral wall is not vertical along its height from said top to said base; and

a layer of doped silicon dioxide over and in contact with said spacer, over and in contact with said undoped silicon dioxide cap, and adjacent to and in contact with said contact plug, wherein a ~~refractory metal~~ conductive layer is disposed along said lateral wall of said contact plug, said ~~refractory metal~~ conductive layer having said contact plug on one of its two opposite sides and having said spacer and said layer of doped silicon dioxide on the other of said sides, such that said ~~refractory metal~~ conductive layer ~~comprises one of the~~

~~materials selected from the group consisting of~~ is a refractory metal, ~~a refractory metal silicide, and combinations thereof.~~

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